General fire precautions

181 If there is a fire, people need to be able to evacuate the structure and possibly the construction site itself to reach a place of safety. **It cannot be over-emphasised that the main aim is to ensure everyone reaches safety if there is a fire.** The means of escape may need to be considered daily on fast-tracked projects.

182 Buildings are often at their most susceptible during the construction phase. Some timber frame structures are vulnerable to rapid fire spread and possible collapse in the early stages of construction as the timber is not protected. Other building types may be more at risk later on in the contract when there is an increased amount of flammable material such as packing or solvents. Many modern building types involve the on-site storage of large quantities of combustible materials (often insulation).

183 The term general fire precaution is used to describe the structural features and equipment needed to achieve this aim. GFP include such things as:

- escape routes and fire exits;
- fire-fighting equipment;
- raising the alarm;
- making emergency plans; and
- limiting the spread of fire (compartmentation).

184 The GFPs needed will vary from site to site. Sometimes they will be very simple and other times much more complicated, depending on the risks involved at each stage of the construction process. But, they all need to take account of the size of the site, the number of people present and the nature of the work being done. Individual elements of GFPs must be considered as part of the overall package and not in isolation.

185 The purpose of this section is to help decide which GFPs are appropriate in particular construction circumstances. An essential requirement is that GFPs and people's ability to escape should not depend on ad hoc arrangements, such as the use of manipulative devices, eg portable or throw-out ladders, or rely on rescue by others, such as the fire and rescue service.

Means of escape

186 Escape routes need to be available for everyone on the site. On open-air sites and unenclosed, single-storey structures, such routes may be both obvious and plentiful. However, in more complicated structures, especially where work is above or below ground, more detailed consideration will be needed:

- Proper provision is needed for all workers and visitors wherever they are and however transient the activity, eg workers on the roof or in a plant or lift gear room.
- During the course of construction, escape routes are likely to change and possibly become unavailable. It is important that replacement routes are identified and provided early.
- Building designs often incorporate fire escape routes for the eventual occupiers. For new buildings, these should be installed at the earliest stage possible to make them available for those undertaking the construction work. For buildings being refurbished, try to arrange the work to make use of existing escape routes and keep them available.
- In an emergency, escape via a scaffold is difficult. Try to minimise reliance on it. Where possible, provide well-separated, alternative access from a scaffold to escape routes in the main building floor. (If this is not possible, see paragraph 207).

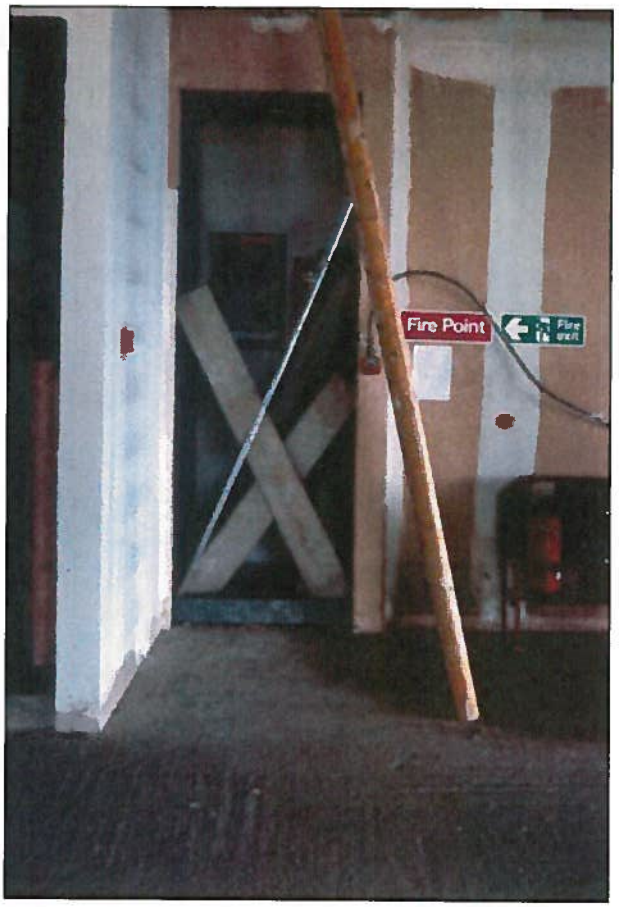

Figure 7 Avoid creating dead-ends and misleading fire exit signage

- There should normally be at least two escape routes offering escape in different directions.
- Tower crane operators (or people in similar vulnerable or difficult areas) must be considered and the necessary controls implemented.

187 Escape routes need to be clear, uncomplicated passageways, properly maintained, prominently signed (see paragraph 214), and kept free of obstruction.

188 A basic principle of escape routes is that any person confronted by an outbreak of fire, or the effects of it, can turn away from it or pass it safely to reach a place of safety (see Figure 7).

189 Where this cannot be realistically accommodated, it is important to ensure that the risk of being trapped by a fire in dead-end situations is minimised. The risk can be reduced by ensuring that anybody in a dead-end does not have to pass through an area of higher fire hazard to reach a place of safety, and keeping the distance they have to travel in the dead-end as short as possible. For example:

- where operations of high fire risk are carried out, such as laying floor coverings or work on pipes which have carried flammable materials, nobody should have to negotiate their way past the work area or plant to make their escape; and/or
- combustible materials should not be stored or allowed to accumulate at the exits from dead-ends, such as by doorways from rooms or along narrow or restricted escape routes from dead-ends, such as corridors.

Table 1 Maximum travel distances

	Fire hazard		
	Lower	*Normal*	*Higher*
Enclosed structures:			
Alternative	60 m	45 m	25 m
Dead-end	18 m	18 m	12 m
Semi-open structures:			
Alternative	200 m	100 m	60 m
Dead-end	25 m	18 m	12 m

Notes

Semi-open structures are completed or partially constructed structures in which there are substantial openings in the roof or external walls, which would allow smoke and heat from any fire to readily disperse, and which are not at risk of exposure from radiation or direct impingement from a fire on the site.

Alternative escape routes should, where possible, proceed in substantially opposite directions. The principle is that they are sufficiently apart that any fire should not immediately affect both routes. As such, they should not be less than 45 ° apart.

Dead-end travel distances are significantly restricted. This is so people have time to negotiate their way past any fire between them and the exit before it threatens their escape.

Lower-hazard areas are those where there is very little flammable or combustible material present and the likelihood of fire occurring is low. Examples could be steel or concrete clad framework or structures in pre-fitting-out stages.

Normal-hazard areas will cover the majority of situations. Flammable and combustible materials are present, but of such a type and disposition that any fire will initially be localised.

Higher-hazard areas are locations where significant quantities of flammable or combustible materials are present of such a type that, in the event of a fire, rapid spread will occur, possibly accompanied by evolution of copious amounts of smoke or fume. Normal precautions to minimise the fire load should ensure that such areas are rare on construction sites. Examples of where they might occur are demolition or refurbishment work involving oil-contaminated wooden floors or linings, and fixing floor and wall coverings using flammable adhesives.

Travel distance

190 In a fire the effects of smoke and heat can spread quickly. It is important not to over-estimate how far people can travel before they are adversely affected by fire. Appropriate distances and the time taken to reach safety will depend on various factors, including how quickly the fire grows, the structure and layout of the building, the location of the fire and where people are relative to this.

191 Various fire safety guides give different travel distances for different classes of buildings, however, the following distances are for guidance only and may vary according to the risk assessment.

192 Table 1 gives maximum travel distances to a place of safety which experience has shown can be considered acceptable for a variety of situations. The distances given are from the fire to an exit from the structure, typically a door, leading to the outside at ground level, or to a stairway or compartment protected against fire (see Stairways, paragraph 197 and Compartmentation, paragraph 243).

193 The travel distances are measured as the actual distance a person must walk and not as the crow flies. Care should be taken to minimise obstructions so that maximum travel distances are not exceeded. It is sensible to arrange the work to keep travel distances as short as possible.

194 This guidance recommends that workplaces, wherever possible, have two separate means of escape in case of fire and, in the case of higher risk buildings, recommends a maximum distance of 25 m to safety, or to a protected route out of the premises.

195 It is important to remember that all recommendations such as travel distances are guidelines and must be considered as part of the overall package of fire protection measures. Variations from individual advisory standards have to be matched by a commensurate increase in other fire protection measures.

196 Some building trades associations issue their own specific guidance for particular construction methods and, in so doing, recommend travel distances slightly higher than those advised in the table above. However, these trade associations base these higher values on requirements that their members enhance other fire safety measures. One example is the UK Timber Frame Association guidance, which recommends a maximum travel distance of 35 m, provided that enhanced fire warning systems have been installed, and they include strategically placed automatic fire detection to give the earliest warning of fire to occupants. The earlier warning gives slightly more time for escape and to cover the additional travel distance.

Stairways

197 Careful consideration needs to be given to the means of escape from work areas above or below ground level. It is especially important to ensure that the stairways and ladders are located or protected so that any fire will not prevent people using them. Those planning the project should consider evacuation routes as part of the process and ensure that staircases are provided in preference to ladders where reasonably practical.

198 Except for small two-storey buildings with travel distances well within those given in Table 1 (refer to paragraphs 190–196) for dead-end travel, there is normally a need for at least one stairway to be protected against any fire in the main work area affecting it. In the finished building, this is typically provided by situating the stairway in its own dedicated, fire-resisting shaft. In these circumstances, the travel distance is measured from the worksite to the door of the protected stairway.

199 Protected stairways will be a feature in many buildings. Therefore, it is a sensible precaution to install these and make them available as early as is practicable in the construction of new structures, before fire risks increase, such as when fitting-out starts.

200 Ceiling, wall or floor coverings which, if ignited, would allow the fire to spread rapidly, or the effects from it to be exacerbated, should not be used in escape stairways. The ideal surfaces are plaster or concrete, which may be painted or sealed, as appropriate. Protective coverings in escape stairways should be flame retardant (see paragraph 168).

201 Where possible, it is sensible to try and provide alternative protected stairways. For structures which are more than four storeys above ground, this is considered essential. With the exception of small basements, on subterranean structures, at least one stairway should exit to the open air at ground level.

Doors

202 Doors giving access to protected stairways should be fitted as early as possible. They need to be fire resistant and fitted with effective proprietary self-closing devices (see Figure 8a/b). Where necessary, gaps between doors and their frames should be suitably fitted with intumescent strip and smoke seals. The nominal minimum period of fire resistance considered appropriate for protected stairways is 30 minutes, which the doors and door set should be designed to meet.

Figure 8(a) Keep fire exits clearly signed and free from obstructions

Figure 8(b) This escape route will quickly fill with smoke in a fire because no fire door is fitted

203 The doors leading to the protected stairway and the final exit from it should open outwards in the direction that people will escape (if more than 60 persons are expected to use them). Revolving doors are not considered suitable as they can jam. For similar reasons, avoid sliding doors.

204 The doors must be easily and immediately openable from the escape side, other than by use of a key. If security is required, proprietary fastenings should be used, such as those which comply with BS EN 1125: 2008 or other relevant standards. Security doors and turnstiles should be configured in such a way that they do not prevent rapid egress from the site in case of an emergency.

205 If it is necessary to protect a stairway, corridor or other circulation spaces to ensure safe travel distances, the integrity of the enclosure is critical to its safe use in an emergency. Check that the doors are properly maintained and closed correctly. It is also important to check that there are no other openings present or made, eg for pipes, wiring and ductwork. If there are, infill them at the earliest opportunity. In refurbishment work, do not assume that there are no holes breaching the enclosure in the existing structure. Any gap that may cause a fire to spread from one side to another should be suitably fire stopped with fire-resisting materials. Fire can also spread rapidly over false ceilings.

External escape stairs and ladders

206 If the nature of the work means it is not reasonable to provide or maintain an internal protected stairway, external temporary escape stairs may be provided instead. Adequate stairways can be constructed from scaffolding (see Figure 9), or using a proprietary system. The important requirement is that the external wall against which the stairway is erected should be imperforate and afford a nominal period of 30 minutes' fire resistance for 9 m vertically below the stairway and 1.8 m either side and above, as measured from the stair treads. This means that all doors, apart from the uppermost one leading onto the external stairway, should have 30 minutes' fire resistance and be self-closing. Any other openings, including windows, which are not of fire-resisting construction, should be suitably protected, eg with plasterboard, proprietary mineral fibre-reinforced cement panels or steel sheets.

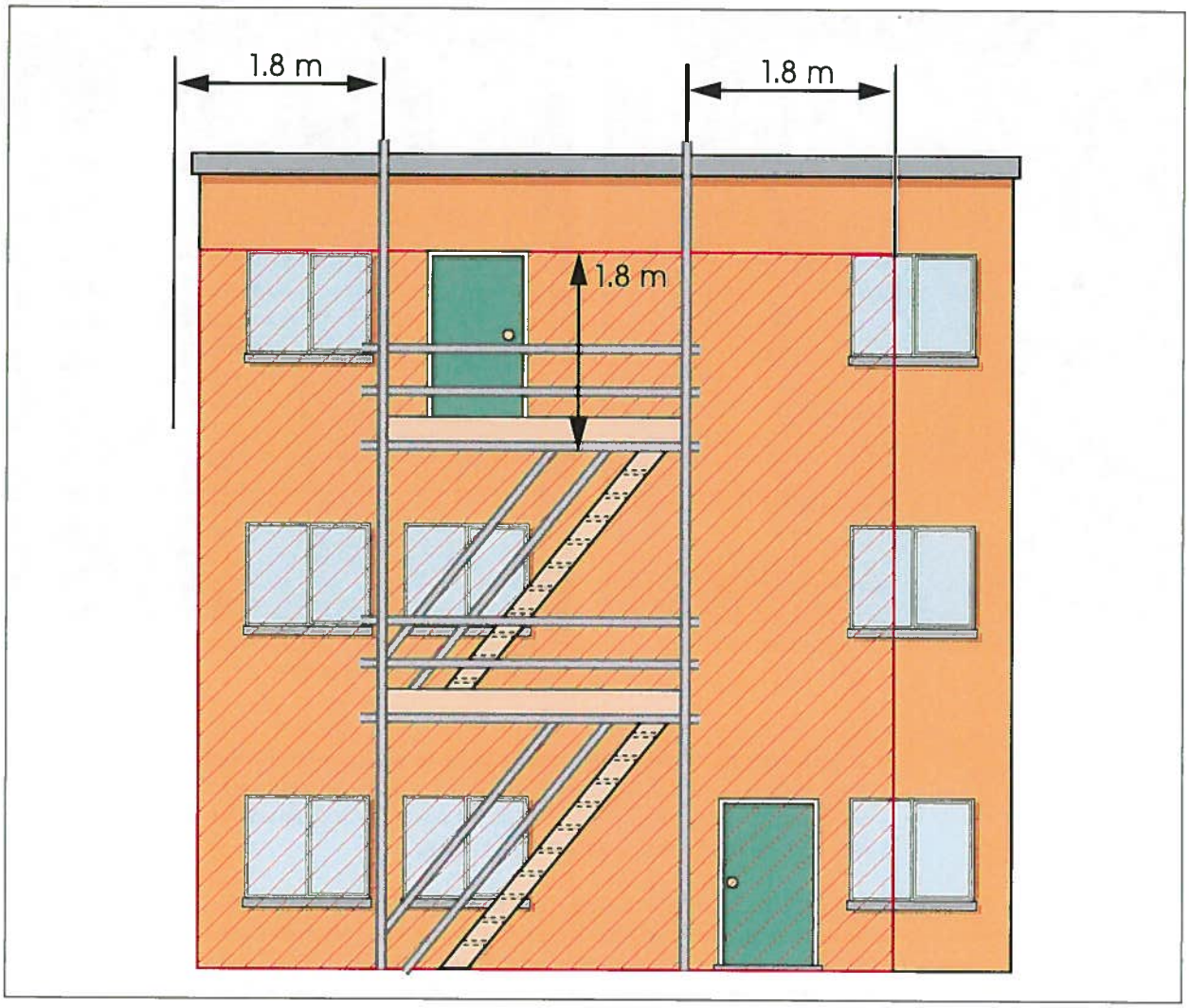

Figure 9 Temporary scaffold-based escape routes need to be protected from fire inside the building. The windows inside the shaded area need to be blocked off with fire-resisting material

207 In the open air, such as work on the initial framework of a structure, it is unlikely that an imperforate barrier will be available to separate the escape stairway from the work area. In such circumstances, unless the travel distances are well within those given in Table 1 (refer to paragraphs 190–196) for dead-end travel, at least two alternative routes should be provided. These should be well apart, ideally at opposite ends. If the structure or building is within a sheeted enclosure, eg for weather protection, environmental or safety reasons, at least one of the routes should be outside the enclosure (see Figure 10).

Escape route sizing

208 While stairways etc may be adequate for normal entry and exit, it is important not to overestimate their capacity in an emergency, when 'bottlenecks' can easily occur. Recommended widths are related to the number of people expected to use them in an emergency. For example, a stairway (in a building under construction) serving two floors should normally be a minimum of 1 m wide to adequately cater for about 200 people. However, if the door leading to or from this is only 750 mm wide, the escape route via this door is only considered adequate for about 100 people.

209 More detailed advice on the size of escape routes can be found in BS 9999 and in Approved Document B and the Technical Standards that support the Building

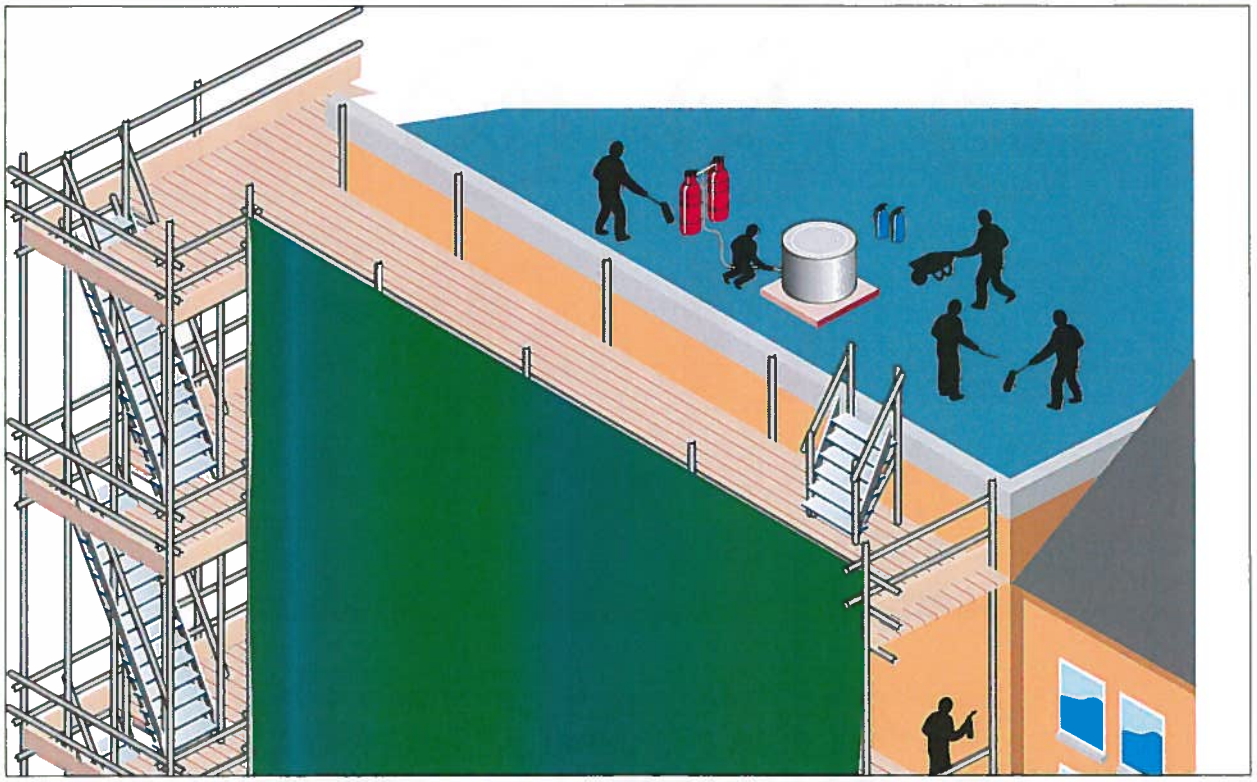

Figure 10 In this job, hot work on the roof and window renovation using blowlamps and substantial amounts of flammable substances mean the fire risk is high. Escape via ladders inside the sheeting could be difficult so external access is provided at one end. Some scaffold components have been omitted for clarity, eg roof edge protection is required. The escape route should lead away from the enclosure, where possible

Regulations and Building Standard (Scotland) Regulations respectively. The majority of structures will be built in compliance with one of these. Therefore, in most cases, the early installation of these escape routes will provide adequate means of escape during construction work. However, if during the construction work the number of people present is greater than the design maximum of the finished building, additional escape routes, or increased sizing of these, might well be necessary.

210 When temporary escape routes are required for changes in level (ie from one floor to another) you should consider the installation of proprietary all-metal system staircases. These can be adapted to any scaffold. If there are practical reasons why these cannot be used, such as a lack of space, under certain limited circumstances a ladder may be acceptable instead of stairs. Remember that fire precautions during the build should be considered at the design stage to ensure there is enough space for adequate precautions.

211 Remember, the speed at which people can escape via ladders is much slower. Ladders may be suitable for simple projects and for small numbers of able-bodied, trained staff. On complex or multi-storey projects proprietary stairwells should be used if reasonably practicable. It may be possible to sequence the building to commission early the permanent stairs to be used as an escape route.

Assembly points

212 All designated escape exits from the structure should give direct access to an unenclosed space in the open air at ground level. From here, there should be an unobstructed passageway from the structure to a place of safety where people can assemble and be accounted for. Regard needs to be given to the size and location of these assembly points:

Figure 11 Emergency signs

- on small sites – the pavement outside may be adequate; (provided this does not obstruct the fire service on their arrival);
- on larger sites – arrangements may have to be made to make use of an area such as a car park; and
- on sites such as chemical refineries – a safe refuge such as a plant control room may have to be used. Where the site is in operation, a responsible person from the company should be consulted regarding a safe assembly point.

213 Where the construction site is surrounded by a hoarding or fence and the assembly point is outside this, an adequate number of gates giving access to the assembly point will be needed. There should be clear and unobstructed access to the gates, which should be unlocked and available for use at all times that people are at work on the site.

Emergency signs

214 Escape routes need to be clearly indicated by proper signs (see Figure 11). The Health and Safety (Safety Signs and Signals) Regulations 1996 set the standards for these signs. They should comprise a white pictogram on a green background supplemented with text if appropriate. See HSE guidance L64 *Safety signs and signals: Guidance on regulations*[18] for further details.

215 Signs need to be large enough so that they can be clearly seen and positioned where they are least likely to be obstructed or obscured by smoke. Typically, this is about 2 m above the floor, but the layout of the site may make alternative positioning more appropriate.

216 If emergency lighting is required (see Emergency lighting, paragraph 252), it may be convenient to use units which incorporate the appropriate fire safety sign. Photo-luminescent way-marking can also emphasise escape routes where lighting is poor.

217 Supplementary signs may also be required to clarify escape procedures, eg to inform how to open the door if this is not obvious, or where a patent security device is fitted, such as a 'Push bar to open' sign. Similarly, where there is danger that a fire exit may become obstructed, a conspicuous 'Keep clear – Fire escape' sign should be displayed. Signs complying with BS 5499: Part 1: 2002 are acceptable.

218 Signs need to be sufficiently durable to withstand site conditions, securely fastened and properly maintained (including kept clean).

219 If circumstances alter and any sign becomes inappropriate it should be removed. For example, if an escape route is changed it is imperative that signs giving misleading or confusing information are taken down and signs indicating the new route are displayed.

220 Training should be given to all workers (not forgetting workers that are not good at reading or for whom English is not their first language) so that they fully understand the signage in a fire emergency to ensure their safe escape.

Fire alarms

221 The aim of any fire warning system is to ensure that people on the site are alerted to make their escape before a fire becomes life-threatening. The essential requirements of the fire warning signal are that it is distinctive, clearly audible above any other noise and is recognised by all the people on site.

222 False alarms and unwanted fire signals can be costly on any project and can also lead to complacency in those needing to respond. Careful selection of systems and management arrangements can reduce this nuisance.

223 The sophistication of the method of giving warning of fire will vary from site to site. For example:

- only on very small open-air sites, or those involving small buildings and structures, 'word of mouth' may be adequate;
- on a very limited number of open-air sites, or those involving buildings and structures with a very limited number of rooms, such that a shout of 'fire' might not be heard or could be misunderstood, a small self-contained proprietary fire alarm unit may well be needed;
- it is expected on the majority of sites that an inter-connecting (could be wired-in or wireless) system (see Figure 12) of call-points and sounders will be required to provide an effective fire warning system. For example, one that meets the requirements of BS 5839: 1: 2002 + A2: 2008; and
- consideration should be given to visual alarm systems (or other proprietary measures) for noisy areas or where there are workers who suffer from a hearing impairment.

224 Fire alarm systems will often be fitted as part of the construction work. Alternatively, buildings may have a wired-in fire alarm system already installed. Try and plan the work to install the fire alarm system as early as possible and, where a system is already installed, keep it in working order for as long as possible. Where they are relied on during the construction phase, it is vital that existing systems are not inadvertently disabled, for instance during work on electrical systems in refurbishment work. If they are disabled for any reason, alternative arrangements need to be provided.

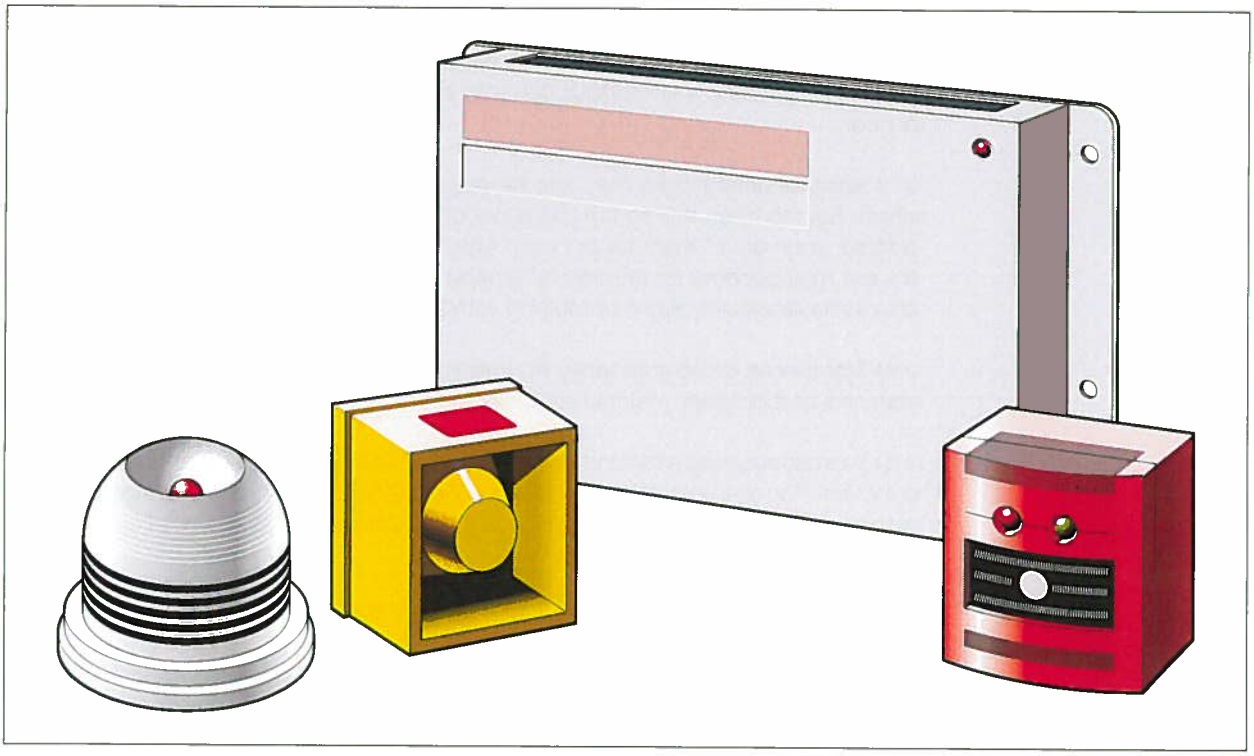

Figure 12 Alarms should be appropriate; on the majority of larger sites alarms should be interconnected (either wired or wireless)

225 There is not normally any need for automatic fire detectors to be fitted during construction work. However, on high-risk sites or in temporary accommodation units (TAUs) such as site offices, if there are locations where a fire might occur and develop unnoticed until it threatens people's means of escape, detectors may be appropriate. Domestic type smoke detectors are not considered appropriate on complex multi-storey sites, however, on small lower risk sites or small (TAUs) they may be acceptable.

226 Indicator panels sometimes form part of more sophisticated alarm systems. They can provide information on the location of the fire, though this may prove erroneous if a call point is activated elsewhere than in the vicinity of the fire. However, providing people are aware of the constraints of the system and understand what the signals mean, they can help inform what emergency actions have been taken, and be of use to the attending fire service.

227 When a fire is detected and the alarm raised, everyone should make their immediate escape without delay. If it is possible that a false alarm could cause significant problems, procedures to verify the outbreak of a fire should be developed. For example, on raising the alarm, perhaps by activation of a call-point, an intercom system might be provided adjacent to this to allow verbal confirmation. This could be to a control centre from which the main alarm is then raised. Alternatively, the person in the control centre might be in radio contact with somebody on the fire floor. Safeguards need to be built into such procedures to ensure that, while anyone is on site, the control centre is **always** occupied (including during breaks) and, if the system for verbal communication fails, effective sounding of the alarm is not delayed.

228 The operation and effectiveness of the fire alarm system over the entire site should be:

- routinely checked (weekly) and tested by a nominated and competent person; and
- periodically serviced and any necessary rectification or repair carried out by a competent person having the appropriate level of training and experience.

229 The work should be carried out in accordance with the supplier's instructions or, where relevant, to an appropriate standard, for example, BS 5839: 1: 2002 + A2: 2008. Keep records of the work carried out. It is particularly important to check the effective operation in practice of the alarm systems that rely on verbal communications described in paragraph 227.

230 It is especially important to ensure that, as the site develops, the alarm system is modified so that effective coverage of the entire site is maintained.

231 General means for communication should be tested daily, eg portable radios or any intercom devices should be checked at the start of shifts. Servicing should be in accordance with supplier recommendations.

Fire-fighting equipment

232 As well as providing fire extinguishers for specific activities, such as hot work or LPG storage, they should also be located at identified fire points around the site. Unless the equipment itself is predominantly red in colour and the location self-evident, identification of the fire point can be achieved by providing a stand which is substantially red in colour, or providing an appropriate safety sign (ie one which complies with the Health and Safety (Safety Signs and Signals) Regulations 1996 or BS 5499: Part 1: 2002. Fire extinguishers should be located on hooks or stands to keep them above ground level.

233 The primary purpose of fire extinguishers is to tackle incipient fires to prevent them becoming larger, or to aid an escape. Putting out larger fires is the fire service's role and, as such, should not be tackled by site workers.

234 The extinguishers should be appropriate to the nature of the potential fire. For:

- wood, paper and cloth, use a water, foam or multi-purpose dry powder extinguisher;
- flammable liquids, use a dry powder or foam extinguisher; and
- electrical items, use a carbon dioxide (CO_2) or dry powder extinguisher.

235 Extinguishers should conform to a recognised standard, such as BS EN 3–7: 2004. It is also important that there is an appropriate scheme to ensure they are regularly checked and properly maintained. This is not only to ensure that they are available and ready for use, but that accidents do not occur to the person using them.

236 Examine fire extinguishers and hose reels at least annually in accordance with a recognised procedure, such as that in BS 5306: Part 3, 2009 and BS 5306: Part 1, 2006 respectively. The work should be carried out by a competent person who has received appropriate training. The date and results of the examinations should be recorded, often on a service sticker attached to the individual piece of equipment, so that the particular extinguisher or hose reel checked is identifiable.

237 The number and type of extinguishers present depends on the fire hazard. For a typical spread of fire hazards, the following is considered to provide a reasonable level of cover per 200 m^2 of floor area, with no fewer than two each of (a) and (b) on each floor:

- one 9 litre water or foam; and
- one CO_2 extinguisher (at least 1.1 kg).

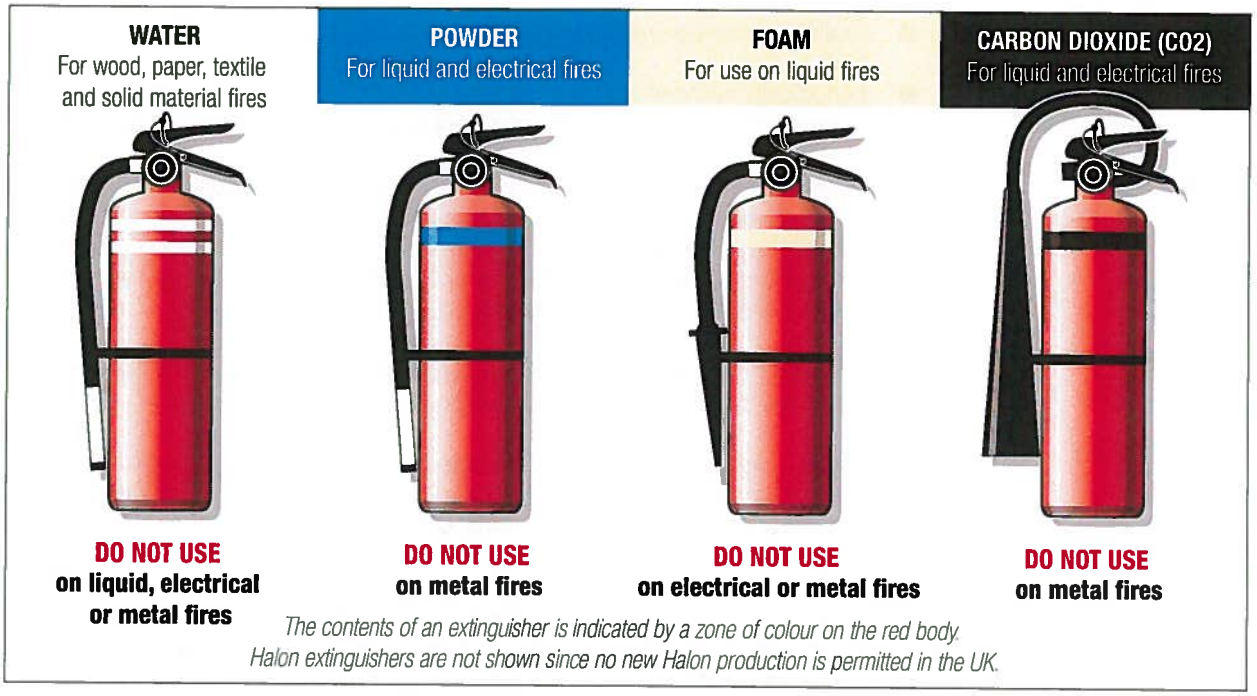

Figure 13 A selection of fire extinguishers. Fire extinguishers complying with BS EN 3 are red with a coloured zone identifying the extinguishing agent (eg blue for dry powder)

Note: Dry powder extinguishers may be provided in addition or substituted for any of these extinguishers, especially where the nature of the fire hazard warrants this. Dry powder does not have a cooling effect and may reduce visibility.

238 Hose reels may also be used instead of the water-based extinguishers. One per 800 m^2 of floor area is recommended, but make sure it can reach all points of the area to be covered. Hose reels should be of an appropriate standard, such as BS 5306: Part 1, 2006 and, as with extinguishers, they need to be regularly checked, properly maintained and used by trained personnel.

239 It is important that everyone knows how to use the fire-fighting equipment. All fire-fighting equipment should have clear operating instructions with it. Those carrying out higher risk activities, such as hot work, need to be competent in the use of the fire-fighting equipment provided and training will normally be required to achieve this.

240 Larger and more complex structures, such as multi-storey buildings, may have fixed fire-fighting systems installed. These may range from dry and wet risers to automatic sprinkler systems. Dry and wet risers are provided for the fire service to tackle a fire quickly. The continued availability of these in existing buildings, and their early commissioning in new buildings, is therefore recommended. Similarly with sprinkler systems, it is worth planning the work so that these are available for as much of the construction phase as possible. Where risers are provided, liaison should be established with the fire service and the access points should be reviewed periodically.

241 Recognition should be given that sprinkler provision may have allowed for reduced fire resistance or extended travel distances. At construction stage this should considered and be incorporated into any fire evacuation planning.

242 If working on an existing building fitted with fire-engineered solutions such as sprinklers or smoke control and these are put offline, this needs to be reflected in the assessments and it may be necessary to liaise with the local fire service.